REC 15-456

WES Energy & Environment, LLC
902 Market Street
Meadville, PA 16335
Office: (814) 337-8223

October 12, 2015

Deborah A. Howland
Executive Director
New Hampshire Public Utilities Commission
21 South Fruit Street, Suite 10
Concord, NH 03301-2429

Re: Application for Class I Thermal Renewable Energy Source Eligibility for Charlestown Middle School

Dear Ms. Howland,

Enclosed is Fall Mountain Regional School District's application for Class I Thermal Renewable Energy Source eligibility for Charlestown Middle School. This facility completed its installation in fall 2014, and has implemented a metering protocol to meet the metering rules as per PUC 2506. This is being submitted along with 1 other school facility owned by Fall Mountain Regional School District.

WES E&E thanks the PUC staff for all their efforts in making the Thermal RECs in NH a reality, and is pleased to submit this application. Please do not hesitate to call either Fall Mountain Regional School District or me with any questions or clarifications on the application.

Sincerely,

WES Energy and Environment, LLC

Daniel A. Wilson
Vice President

Attachments:

- Charlestown Middle School TREC Application

State of New Hampshire
Public Utilities Commission
21 S. Fruit Street, Suite 10, Concord, NH 03301-2429

DRAFT

APPLICATION FORM FOR

RENEWABLE ENERGY SOURCE ELIGIBILITY FOR
CLASS I THERMAL SOURCES WITH RENEWABLE THERMAL ENERGY CAPACITY GREATER THAN
150,000 BTU/HR

Pursuant to New Hampshire Administrative Code PUC 2500 Rules

- Please submit one (1) original and two (2) paper copies of the completed application and cover letter* to:

  Debra A. Howland
  Executive Director
  New Hampshire Public Utilities Commission
  21 South Fruit Street, Suite 10
  Concord, NH 03301-2429

- Send an electronic version of the completed application and the cover letter electronically to executive.director@puc.nh.gov.

* The cover letter must include complete contact information and identify the renewable energy class for which the applicant seeks eligibility. Pursuant to PUC 2505.01, the Commission is required to render a decision on an application within 45 days of receiving a completed application.

If you have any questions please contact Barbara Bernstein at (603) 271-6011 or Barbara.Bernstein@puc.nh.gov.

Only facilities that began operation after January 1, 2013 are eligible.

Is this facility part of a Commission approved aggregation?
Yes X No ____
Aggregator's Company Name: WES Energy & Environment, LLC
Aggregator Contact Information: 902 Market St, Meadville, PA 16335 (814) 337-8223

Contents

Attachment Labeling Instructions

Please label all attachments by Part and Question number to which they apply (e.g. Part 3-7). For electronic submission, name each attachment file using the Owner Name and Part and Question number (e.g. Pearson Part 3-7).

Part 1. General Application Information

Please provide the following information:

Applicant

Name: Fall Mountain Regional School District

Mailing Address: 159 East Street

Town/City: Charlestown State: NH Zip Code: 03603

Primary Contact: Jamie Teague

Telephone: (603) 826-7756 Cell: n/a

Email Address: jteague@sau60.org

Facility

Name: Charlestown Middle School

Physical Address: 307 Main Street

Town/City: Charlestown State: NH Zip Code: 03603

If the facility does not have a physical address, the Latitude: _____ & Longitude _____

Installer

Name: Froling Energy

Installer License Number: n/a

Mailing Address: 590 Hancock Road

Town/City: Peterborough State: NH Zip Code: 03458

Primary Contact: Mark Froling

Telephone: (603) 924-1001 Cell: n/a

Email Address: mark@frolingenergy.com

If the equipment was installed by the facility owner, check here: ☐

Facility Operator

If the facility operator is different from the owner, please provide the following:

Name: _____

Facility Operator Telephone Number: _____

Independent Monitor

Name: Roger M. Thibodeau, PE

Mailing Address: PO BOX 1260

Town/City: Charlestown State: NH Zip Code: 03603

Primary Contact: Roger M. Thibodeau, PE

Telephone: (603) 826-5115 Cell: (603) 398-4733

Email Address: twnsteng@aol.com

NEPOOL/GIS Asset ID and Facility Code

In order to qualify your facility's thermal energy production for RECs, you must register with the NEPOOL – GIS. Contact information for the GIS administrator follows:

James Webb
Registry Administrator, APX Environmental Markets
224 Airport Parkway, Suite 600, San Jose, CA 95110
Office: 408.517.2174
jwebb@apx.com

Mr. Webb will assist you in obtaining a GIS facility code and an ISO-New England asset ID number.

GIS Facility Code # (Application for GIS code is in progress) Asset ID #

1. Has the facility been certified under another non-federal jurisdiction's renewable portfolio standards?

Yes [ ] No [X]

If you selected yes, *please provide proof of certification in the form of an attached document as Attachment 1-1.*

2. Attach any supplementary documentation that will help in classification of the facility as Attachment 1-9

Part 2. Technology Specific Data

All Technologies

Fuel type (solar, geothermal, or biomass): biomass

Rated Thermal Capacity (Btu/hr): 684,200 Btu/hr

Date of initial operation using renewable fuels: 10/15/2014

Biomass

If a thermal biomass facility, provide proof of New Hampshire Department of Environmental Services approval that the facility meets the emissions requirements set forth in Puc 2500, as Attachment 2-1.

Solar Thermal

If a solar thermal facility, please provide the Solar Rating and Certification Corporation rating based on Mildly Cloudy C (kBtu/day): _____

Geothermal

If a geothermal facility, please provide the following:

The coefficient of performance (COP): _____

The energy efficiency ratio of the system: _____

Part 3. Metering and Measurement of Thermal Energy and REC Calculations

This section deals with the thermal metering system including methods for calculation and reporting useful thermal energy. **A copy of PUC 2506.04 of the RPS rules is included as Appendix A.**

Using the table below, identify the thermal metering system or custom components (e.g., heat meters, flow meters, pressure and temperature sensors) used to measure the useful thermal energy and enter the accuracy of measurement for the entire system:

System or Component	Product name	Product Manufacturer	Model No.
Flow Meter	BTU Meter	Clark	19-027
Temp Sensor	Temp Sensor	Clark	RTD-2
Total System Accuracy (Percent)	1%		

Attach component specification sheets (Accuracy, Operating Ranges) as Attachment 3-1. [X]

Attach a simple schematic identifying the location of each sensor that is part of the metering system as Attachment 3-2. [X]

Check the applicable standard for meter accuracy prescribed in Puc 2506.04 among the six choices below (compliance with Puc 2506.04 shall be certified by a professional engineer licensed by the state of New Hampshire and in good standing):

If the facility is a large thermal source using a liquid or air based system, check the method that applies:

A. Installation and use of heat meters capable of meeting the accuracy provisions of European Standard EN 1434 published by CEN, the European Committee for Standardization. The heat meter shall have the highest Class flow meter that will cover the design flow range at the point of measurement and a temperature sensor pair of Class 5K or lower. [X]

B. Installation and use of meters that do not comply with European Standard EN 1434, provided that the manufacturers' guaranteed accuracy of the meters is ±5.0% or better, [ ]

C. Use of an alternative metering method approved pursuant to Puc 2506.06. [ ]

If the facility is a large thermal source using a steam-based system, check the method that applies:

D. Installation and use of meters with accuracy of ±3.0% or better. [ ]

E. Installation and use of meters with system accuracy that do not meet D but are ±5% or better. [ ]

F. Use of an alternative metering method approved pursuant to Puc 2506.06. [ ]

Please summarize the manufacturer's recommended methods and frequency for metering system calibration and provide reference for source document (e.g. owners/operators manual):

a "check cal" should be performed on a periodic basis to verify that the equipment is measuring within tolerance

REC Calculation Discount factor for meter accuracy (Enter 0 if no discount is required): 0 %

If the meters used to measure useful thermal energy comply with the accuracy of the European Standard EN 1434 for liquid systems or use of meters with accuracy of ±3.0% or better for steam systems enter zero, for all other systems enter the sum total of the manufacturer's guaranteed accuracy of the meters used or the accuracy of the alternative method approved pursuant to Puc 2506.06.

REC Calculation Discount factor for operating energy and thermal energy losses: 2 %

Check the method used for determining the operating energy and thermal loss factor among the choices below:

Default Factor [2%]

- For sources using solar thermal technology, the discount factor shall be 3.0% of the useful thermal energy produced;
- For sources using geothermal technology, the discount factor shall be 3.6% of the useful thermal energy produced;
- For sources using thermal biomass renewable energy technology, the discount factor shall be

2.0% of the useful thermal energy produced.

Actual Metering ☐

- Include a simple schematic identifying the operating energy and thermal energy losses and placement of the meters.

Interim Alternative Metering Method

Until such time as the Puc 2500 rule is finalized applicants may utilize an alternative method as described in the draft rule 2505.02(e)(2):

> *In lieu of the information required by Puc 2505.02 (d) (11) through (13), a thermal source may submit a detailed explanation of the methodology used to measure and calculate thermal energy and an attestation by a professional engineer that is licensed in New Hampshire and in good standing that the methodology for measuring useful thermal energy and calculating certificates is sound.*

Part 4. Affidavits

Owners Affidavit

The following affidavit must be completed by the owner attesting to the accuracy of the contents of the application pursuant to PUC 2505.02 (b) (14).

AFFIDAVIT

I, Jamie J. Teague have reviewed the contents of this application and attest that it is accurate and is signed under the pains and penalties of perjury.

Applicant's Signature _____ Date 10-7-15

Applicant's Printed Name Jamie J. Teague

Subscribed and sworn before me this 7th Day of October (month) in the year 2015

County of Sullivan State of New Hampshire

_____

Notary Public/Justice of the Peace Seal

LORI J. MOWREY, Notary Public
My Commission Expires April 23, 2019

My Commission Expires _____

NH Professional Engineer Affidavit

AFFIDAVIT

I, **Joseph Davey** attest that this facility meets the requirements of the thermal REC eligibility requirements of Puc 2500, including the thermal metering and measurement methodologies and standards and REC calculation methodologies.

Professional Engineer's Signature _____ Date **10/07/15**

Professional Engineer's Printed Name **Joseph Davey**

NH Professional Engineer License Number **7976**

PE Stamp

The State of New Hampshire
DEPARTMENT OF ENVIRONMENTAL SERVICES

Thomas S. Burack, Commissioner

December 12, 2014

Mr. Charles R. Niebling
Innovative Natural Resource Solutions LLC
10 Queen Street
Boscawen, NH 03303

Re: Recommended Certification as a Class I Thermal Renewable Energy Source
Fall Mountain Regional School District
Walpole and Charlestown, NH

Dear Ms. Howland:

In response to your request on behalf of Fall Mountain Regional School District (FMRSD) for certification of the wood pellet boilers located at the Walpole and Charlestown Elementary Schools as an aggregated Class I thermal renewable energy source, the New Hampshire Department of Environmental Services (DES) recommends that the Public Utilities Commission (PUC) grant approval to FMRSD as a Class I thermal renewable energy source eligible to generate renewable energy certificates. A summary of the facility description, DES's review of best management practices (BMP) requirements, and a recommendation for approval are presented below.

Facility Description

Facility Name: Fall Mountain Regional School District (FMRSD)
Locations: Walpole and Charlestown Elementary Schools
Gross Nameplate Capacity: 100 kW or 342,100 BTU/hr x 4
Or per school capacity 200 kW or 684,200 BTU/hr

Primary Fuel: wood pellets

Emissions

By definition, *"Thermal biomass renewable energy technologies"*, requires units rated less than 3 MMBtu/hr gross heat input to meet best management practices (BMP) as established by DES for control of particulate matter (PM) and nitrogen oxides (NOx) emissions. DES herein establishes BMP as conducting boiler tune-ups annually and conducting combustion efficiency testing initially and annually demonstrating results equal to or greater than 99%.

BMP Confirmation

Test data for carbon monoxide (CO) and carbon dioxide (CO_2) concentrations in the exhaust gas were used to determine combustion efficiency using the following equation:

$CE(\%) = 100 \times CO_2 / (CO_2 + CO)$

Where:

CE = combustion efficiency

CO_2 = % by volume of carbon dioxide in the flue gas, and

CO = % by volume of carbon monoxide in the flue gas.

The results of the initial tests indicate that the combustion efficiency meets the required 99%. DES anticipates that FMRSD will be able to meet ongoing BMP annually.

Conclusion and Recommendation for Approval

DES believes that FMRSD currently meets, and annually will meet, the requirements to be certified as a Class I - New Biomass thermal renewable energy source. DES recommends that the PUC certify FMRSD as a Class I thermal renewable energy source eligible to generate thermal renewable energy certificates, on the condition that FMRSD annually demonstrates that BMP continue to be met.

If you have any questions, please contact me at joseph.fontaine@des.nh.gov or (603) 271-6794.

Sincerely

Joseph T. Fontaine
Trading Programs Manager
Air Resources Division

www.clarksol.com

CSEM BTU/Energy Monitor

Energy Monitoring of Heating or Cooling Systems, 3/4" to 10" Pipe

DESCRIPTION

The CSEM is an economical energy flow monitor intended for applications in energy transfer and heating/cooling systems where energy use requires measurement.

In heat exchange loops the CSEM internally calculates the energy gained or lost by the heat exchanger. The energy is calculated based on the the mass volume of liquid passing through the system and the difference in temperature between the supply and return lines. The volume of liquid is measured by means of a Clark ultrasonic flow transmitter. A RTD sensor built into the flowmeter (T_1) measures temperature at the meter. The remote temperature (T_2) is measured by means of a precision RTD sensor mounted in the return pipe.

A scaled pulse output is provided and can be configured to report volume flow rate, mass flow rate or unit of energy. Modbus 485 communications provides an interface with a building automation or monitoring system.

The unit contains non-volatile memory that records flow and energy, and is updated every ten minutes. However, when flow, mass or energy totals are read, the reported values are true current values; the last stored value is added to the current accumulated value when the applicable register is read.

The default medium for the CSEM is water. Other media consisting of water and a certain percentage of glycol up to 60% can be field configured.

APPLICATIONS

- ***HEATING ONLY APPLICATION***
- ***COOLING ONLY APPLICATION***
- ***HEAT RECOVERY APPLICATIONS***
- ***CONDENSATE RECOVERY APPLICATIONS***
- ***EFFICIENCY MEASURING/VERIFICATION***

SPECIFICATIONS

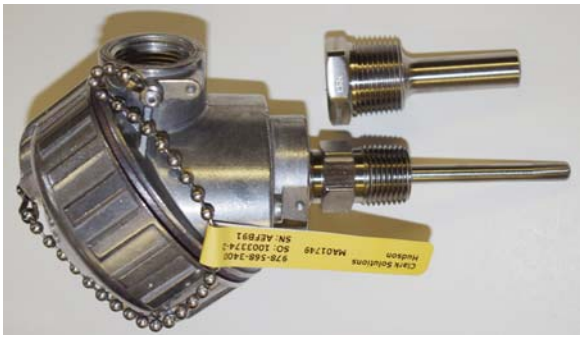
TEMPERATURE MEASUREMENT

RTD integral to Flow Transmitter:
Sensor: 1000 Ohm, Class B, Platinum RTD Element (Alpha= 3.85)
Remote RTD Assembly: 1000 Ohm, Class B, Platinum RTD Element
Option 1 (3/4" & 1" pipe size): 1 RTD packaged in a 1/4" x 2.5" stainless steel sheath with 1/2" NPT brass adjustable compression fitting for mounting in a 1/2" branch of a 3/4" or 1" pipe tee; supplied with 10 ft of 3-wire RTD cable.

Option 2 (3/4" to 10" pipe size): Clark Spring-Loaded RTD Thermowell Assemblies with General Purpose Aluminum Connection Heads are designed for use with, and supplied with, 316 SS thermowells. This design allows 1/4" spring compression to ensure positive contact with the bottom of the thermowell.
Sheath Material & Diameter: 316 SS, 1/4" dia.
Element Connection: 3 wire, screw terminal
Connection to Energy Monitor: 10 ft connecting RTD cable supplied with each model (longer lengths available).
Head Mounting Fittings: 316 SS, 1/2" x 1/2" NPT hex nipple, 1" length
Head & Sheath Termonation: Aluminum screw cover head, 3/4" NPT conduit connection
Thermowell Material: 316L SS
Pipe Conection: 3/4" NPT
Models & Dimensions: See Table 1

Accuracy: Temperature difference used in energy calculation is obtained from a matched pair of RTD's calibrated at factory to report temperature difference to ±(0.1 + 0.002*T) Degs C.
Operating Differential Temperature Range Heating & Cooling:
2 to164°F (1.1°C to 91°C), minimum default factory set as 2°F, consult factory for different value.

Remote Temperature RTD Option 1: Model 43-110 sheathed RTD with 1/2" NPT brass adjustable compression fitting for mounting in a 1/2" branch o f a 3/4"or 1" pipe tee. 10 ft Fixed length of RTD cable supplied.



Remote Temperature RTD Option 2: Model19-(027, 028, 029) Sheathed RTD packaged with thermowell

Figure 1

Table 1

Remote RTD Model & Thermowell Dimension Chart				
Model	**For Pipe Sizes**	**See Figure**	**S**	**U**
43-110	Sheathed RTD with 1/2" NPT brass adjustable compression fitting for mounting in a 1/2" branch o f a 3/4"or 1" pipe tee. 10 ft Fixed length of RTD cable supplied.			
19-027	3/4", 1", 1-1/2" & 2"	1	-	-
19-028	3" & 4"	2	4"	2-1/2"
19-029	6" & 8"	2	6"	4-1/2"
19-030	10"	2	9"	7-1/2"

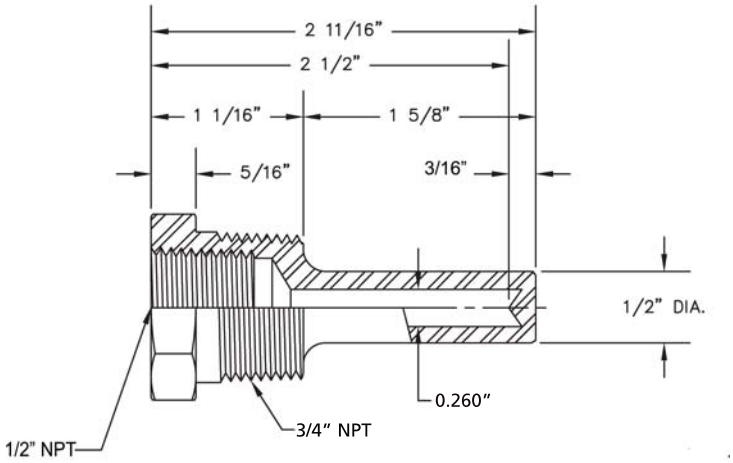
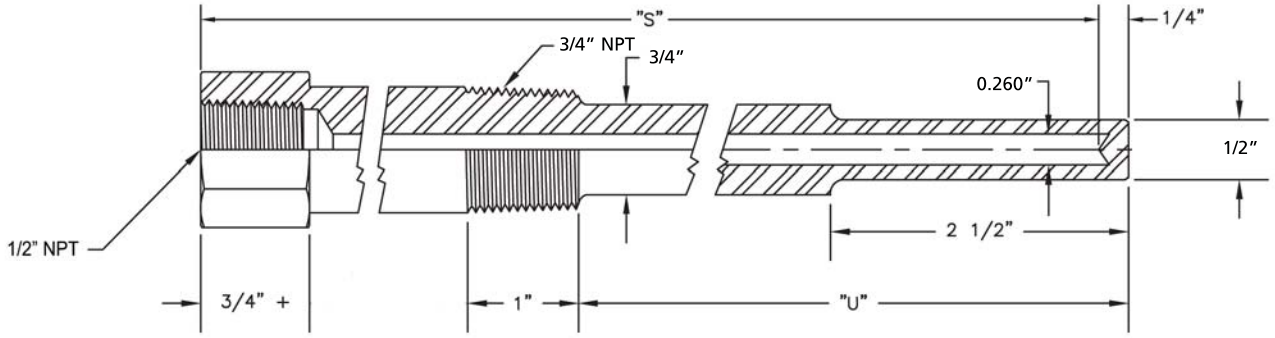


Figure 2



FLOW TRANSMITTER WITH RTD SENSOR & INTEGRATED ELECTRONICS FOR ENERGY CALCULATIONS

Clark Sonic ultrasonic flow transmitters are ideal for measurement of flow rates of acoustically conductive liquids including most clean liquids and many liquids with entrained solids. They are ideal for monitoring flow rate and temperature in heat exchange applications. CSEM flow transmitters are supplied with a built-in platinum 1000 Ohm RTD temperature sensor (T_1) to monitor the media temperature.

Main advantages include excellent long term stability, no pressure drop, broad fluid compatibility, high accuracy and low cost. Also, there are no moving parts.

The output of the transmitter is unaffected by changes in fluid temperature, density and viscosity as the flow calculation is independent of the speed of sound.

Wetted materials include ULTEM® encapsulated ultrasonic transducers with a choice of elastomer seals and Brass body material.

Packaged integral to the CSEM flow sensor are the related circuits for making energy calculations and for providing pulse output and Modbus RS 485 communications.

FLOW TRANSMITTER SPECIFICATIONS

GENERAL

Flow Range: Bi-directional, per "Standard Models" tables 2 & 3
Accuracy: ±0.75% of full scale
Media Oper. Temp. Range: -4 to 190°F (-20 to 87.8°C)
Ambient Oper. Temp. Range: -40 to 190°F (-40 to 87.8°C)
Response Time: 2 seconds
Viscosity Range: 0.2 to 150 cSt (0.2 to 150 mPas)
Liquid Density: 30.6 to 74.9 lb/cu.ft. (490 to 1200 kg/m³)
Max. Working Pressure:
3/4" to 2":250 PSI (17.2 bars)
3" to 10": PerASME 150 flange specification
Pipe Sizes: 3/4", 1", 1 1/2", 2", 3", 4", 6". 8", 10"
Pipe Connections:
See Model Tables 2 & 3
Sizes 3/4" to 2"- Female NPT or BSP
Size 3" to 10": ASME 150 Flange
Electrical Enclosure: Polycarbonate with gasketed cover and 1/2" Liquidtight non-metalic conduit connector
Enclosure Rating: NEMA 4 (IP 65)
Power Supply Voltage: 12 to 36 VDC
Current Consumption: <10 mA
Flow & Error Indication:
Green LED located on the wiring enclosure
Flashing- Making good measurements, flashes in proportion to flow rate
Off- No flow
Steady on- Flow measurement error

WETTED MATERIALS

Ultrasonic Transducers: ULTEM® Encapsulated
Seals: EPDM, Buna-N, Neoprene™, FKM, or other
Body Material:
3/4" to 2":Brass (UNS C83600)
3" to 10": Schedule 40, epoxy coated, carbon steel pipe

OUTPUT

Pulse Output: Can be factory set or field configured to report volume flow rate, mass flow rate or pulse per unit of energy. Output is either an optically isolated NPN transistor with maximum sinking capability to 50 mA from a voltage source of no more than 48 VDC or a voltage output (power supply voltage). Pulse duration is 1 ms when reporting flow rate and 10 ms when reporting unit of energy (consult factory for different pulse duration).
Wiring Connection: Via terminal strip (see wiring diagragm).
Models supplied with:
10 ft 3-conductor RTD cable
1 x 1/2" Liquidtight 90° non-metalic conduit connector for power, pulse output and RS485 cable entry to wiring enclosure
1 x PG-7 Strain relief connector for RTD cable entry to wiring enclosure

Table 2

STANDARD MODELS- 3/4" TO 2"

Model	Pipe Size/Thread Size	Full Scale Ranges & Vol. or Mass Flow Pulse Output (Dependent on Configuration) F.S. GPM Min.	Max.	P_g Pulses/gallon	M_{lb} Pulses/lb	F.S Liters/Min Min.	Max.	P_l Pulses/liter	M_{kg} Pulses/kg
CSEMB34	3/4" NPT or BSP	0.38	25	1200	150	1.50	100	300	300
CSEMB10	1.0" NPT or BSP	0.75	50	600	72	3.00	200	150	150
CSEMB15	1.50" NPT or BSP	1.20	80	360	45	4.50	300	96	96
CSEMB20	2.0" NPT or BSP	1.80	120	240	30	6.8	455	60	60

Table 3

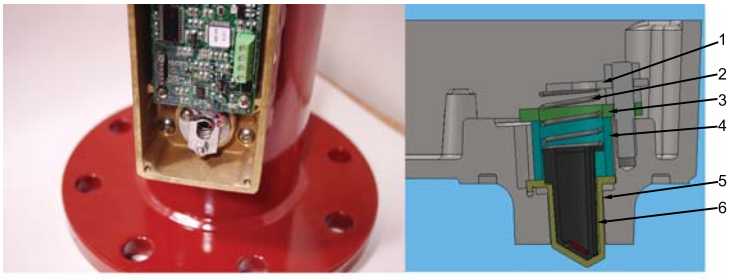
Volume Flow(g/min)= 60 x Frequency/P_g Mass Flow(lbs/min)= 60 x Frequency/M_{lb}
Volume Flow(l/min)= 60 x Frequency/P_l Mass Flow(kg/min)= 60 x Frequency/M_{kg}

STANDARD MODELS- 3" TO 10"

Model	Pipe Size	Full Scale Ranges & Vol. or Mass Flow Pulse Output (Dependent on Configuration) F.S. GPM Min.	Max.	P_g Pulses/gallon	M_{lb} Pulses/lb	F.S Liters/Min Min.	Max.	P_l Pulses/liter	M_{kg} Pulses/kg
CSEMC3	3"	6	400	75	9	23	1500	20	20
CSEMC4	4"	7.5	500	60	7.2	29	1900	16	16
CSEMC6	6"	18	1200	25	3	68	4500	7	7
CSEMC8	8"	30	2000	15	1.8	114	7600	4	4
CSEMC10	10"	45	3000	10	1.2	165	11000	3	3

FIELD REPLACEABLE TRANSDUCER FOR 3" TO 10" SIZES

Volume Flow(g/min)= 60 x Frequency/P_g
Volume Flow(l/min)= 60 x Frequency/P_l
Mass Flow(lb/min)= 60 x Frequency/M_{lb}
Mass Flow(kg/min)= 60 x Frequency/M_{kg}



Transducer Components	
1	Spring Retainer
2	Spring
3	Clamp
4	Bushing
5	Drywell
6	Ultrasonic Transducer

Two opposing CSEMC ultrasonic transducers are inserted into fixed ULTEM® drywells and held in place with light spring force. A locating keyway in the drywell aids insertion and positioning of the transducers. In the event of field failure of a transducer, replacement is straightforward and can be accomplished without removing the pipe spool and shutting down the process.

The electrical PC board can also be field replaced. Calibration factor and other specific information are maintained at the factory for all transmitters shipped.

Energy Measurement:

T_1 RTD is located in the flow sensor
T_2 Remote RTD is installed in a return pipe.
Heating and cooling energy are both measured and totaled in separate registers in model CSEM. The values can be interrogated via the Modbus Master.

1) Heating Mode: $T_1 > T_2$
2) Cooling Mode: $T_2 > T_1$

The unit of energy pulse output functions in the absolute mode, indifferent as to whether in the heating or cooling mode.

System accuracy: EN1434-1, C 900.1, OIML R 75-1 Class 2 & 3 (see Table 4)

Security: Holographic tamper evident label seal with unique serial number provided for electrical enclosure cover. Seal must be broken to affix a jumper for commissioning

Modbus Operability:

Baud Rate: 9600 (default) or 19.2 KB/S
Parity: Selectable, None (default), Even, Odd
Slave Id: 01-255 (default is 02)
Function Codes: 03, 05 & 06 are supported
Exception Codes: 01, 02 & 03 are supported
Data types: Word, Double
Data is sent "Big Endian", i.e. most significant byte first.

Flow and energy data updated every 2 seconds. Turn around time is less than 2 seconds.Since the data is updated every 2 seconds, reading data at intervals greater than the update time will ensure that current values will always be fresh.

Commissioning:

The CSEM communication and other parameters can be pre-configured and programmed at the factory. They can also be field programmed from the user's Modbus Master over the RS-485 network, or by Clark stand alone commissioning software via PC serial or USB port and a RS-485 converter model 43-119 (serial port) or USOPTL4-LS (USB port). 640 Ohm bus termination resistors can be jumper selected on the pcb. Commissioning software can be downloaded from our website, www.clarksol.com.

The software has additional functionality and enables the user to interrogate all registers at once to receive measured quantities. Also, all related units of measurement can be retrieved from the addressed slave meter. In addition, manual datalogging is possible.

Table 4 Accuracy Class Rating Per EN 1434-1 & OIML R 75-1

Percent FS	10.00	20.00	30.00	40.00	50.00	60.00	70.00	80.00	90.00	100.00
Delta T (°C)										
2.00										
2.60										
3.38										
4.39										
5.71										
7.43										
9.65										
12.55										
16.31										
21.21										
27.57										
35.84										
46.60										
60.58										

Class 2 Class 3

About EN 1434-1 max. permissible error of complete heat meters

Class 2: $E = \pm(3+4\Delta\Theta_{min.}/\Delta\Theta + 0.02q_p/q)$
Class 3: $E = \pm(4+4\Delta\Theta_{min.}/\Delta\Theta + 0.05q_p/q)$

Where:

E= Max. permissible Error (%)
$\Delta\Theta_{min.}$ = Lower Limit of Temperature Difference (2°C)
$\Delta\Theta$ = Temperature Difference between Supply & Return of the heat exchange circuit
q_p = Highest flow-rate at which energy meter shall function continuously without maximum permissible errors being exceeded (stated full scale value of CSEM)
q = Flow Rate

Note: Accuracy statements apply to meters with matched temperature probes provided as original equipment from factory.

Table 5- Read Data Registers

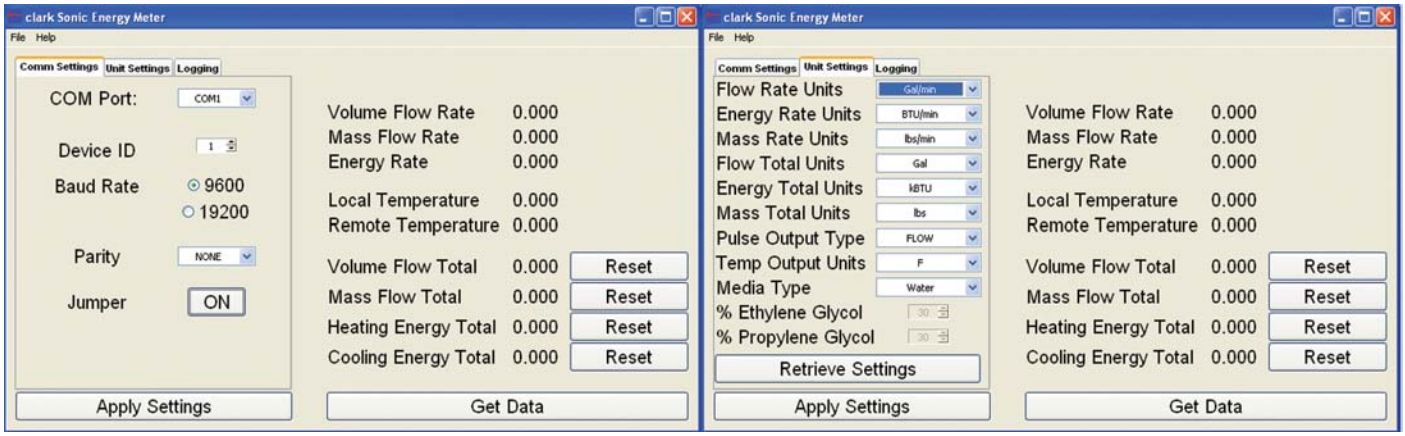
Variable	Register Number	# Registers	Function Code	Data Type	Description
FLOW RATE	40001	2	03	Double	RETURNS FLOW RATE IN SELECTED UNITS
ENERGY RATE	40003	2	03	Double	RETURNS ENERGY RATE IN SELECTED UNITS
MASS RATE	40005	2	03	Double	RETURNS MASS FLOW RATE IN SELECTED UNITS
FLOW TOTAL	40007	2	03	Double	RETURNS TOTAL FLOW IN SELECTED UNITS SINCE LAST RESET
HEATING TOTAL	40009	2	03	Double	RETURNS TOTAL HEAT ENERGY IN SELECTED UNITS SINCE LAST RESET
COOLING TOTAL	40011	2	03	Double	RETURNS TOTAL COOLING ENERGY IN SELECTED UNITS SINCE LAST RESET
MASS TOTAL	40013	2	03	Double	RETURNS TOTAL MASS IN SELECTED UNITS SINCE LAST RESET
LOCAL TEMP	40015	2	03	Double	RETURNS LOCAL TEMPERATURE IN SELECTED UNITS
REMOTE TEMP	40017	2	03	Double	RETURNS REMOTE TEMPERATURE IN SELECTED UNITS
DIFFERENTIAL TEMP	40019	2	03	Double	RETURNS DIFFERENTIAL TEMPERATURE IN SELECTED UNITS

Table 6- Setup Functions, Write Data Registers

Variable	Register Number	# Registers	Function Code	Data Type	Description
SET FLOW RATE UNITS	40101	1	06	WORD	UNITS OF FLOW RATE; 0 = G/M, 1 = L/M
SET ENERGY RATE UNITS	40102	1	06	WORD	UNITS OF ENERGY RATE; 3 = BTU/M, 4 = KBTU/M, 5 = KBTU/HR, 6 = KW
SET MASS FLOW RATE UNITS	40103	1	06	WORD	UNITS OF MASS RATE; 7 = LBS/MIN, 8 = KG/MIN
SET FLOW TOTAL UNITS	40104	1	06	WORD	FLOW TOTAL UNITS; 9 = GALS, 10 = LITERS, 11 = CUBIC METERS
SET ENERGY TOTAL UNITS	40105	1	06	WORD	ENERGY TOTAL UNITS; 12 = kBTU, 13 =W-HRS, 14 = KW-HRS
SET MASS TOTAL UNITS	40106	1	06	WORD	MASS UNITS; 15 = LBS, 16 = KG
SELECT PULSE OUTPUT	40107	1	06	WORD	SELECT ENERGY,FLOW,OR MASS AS PULSE OUTPUT; 0 = FLOW, 1 = ENERGY, 2 = MASS
SELECT TEMPERATURE UNITS	40108	1	06	WORD	SELECT DEG F OR DEG C; 0 = DEG F, 1 = DEG C
SELECT MEDIA TYPE	40109	1	06	WORD	0 =WATER, 1,(2) = ETHYLENE GLYCOL 92% (95.5%), 2(3) = PROPLENE GLYCOL 94% (96%)
SET % GLYCOL	40110	1	06	WORD	ENTER PERCENT ADDED , 10 TO 60
SET PULSE TYPE	40111	1	06	WORD	0 = UNIVERSAL; 2 = HEATING ONLY; 3 = COOLING ONLY

Table 7- Commissioning & Other Functions, Write Data Registers

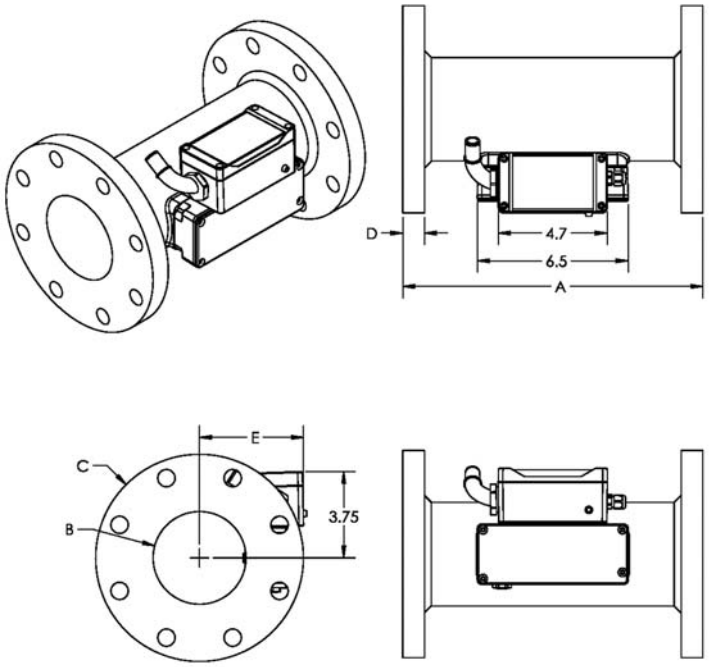
Function	Register Number	# Registers	Function Code	Data Type	Description
SET SLAVE ID	40201	1	06	WORD	02 IS FACTORY SET 0 to 255; Can only be set when commissioning
BAUDRATE	40202	1	06	WORD	19.2 KB 0R 9600 (DEFAULT) 0 = 9600, 1 = 19.2kb; Can only be set when commissioning
SET PARITY	40203	1	06	WORD	NONE, ODD, EVEN (DEFAULT) 0,1,2; Can only be set when commissioning
RESET FLOW TOTAL	00001	1	05	WORD	CLEARS TOTALIZED FLOW
RESET HEATING ENERGY TOTAL	00002	1	05	WORD	CLEARS TOTALIZED HEATING ENERGY (ONLY WITH COMMISSIONING JUMPER INSTALLED)
RESET COOLING ENERGY TOTAL	00003	1	05	WORD	CLEARS TOTALIZED COOLING ENERGY (ONLY WITH COMMISSIONING JUMPER INSTALLED)
RESET MASS TOTAL	00004	1	05	WORD	CLEARS TOTALIZED MASS (ONLY WITH COMMISSIONING JUMPER INSTALLED)



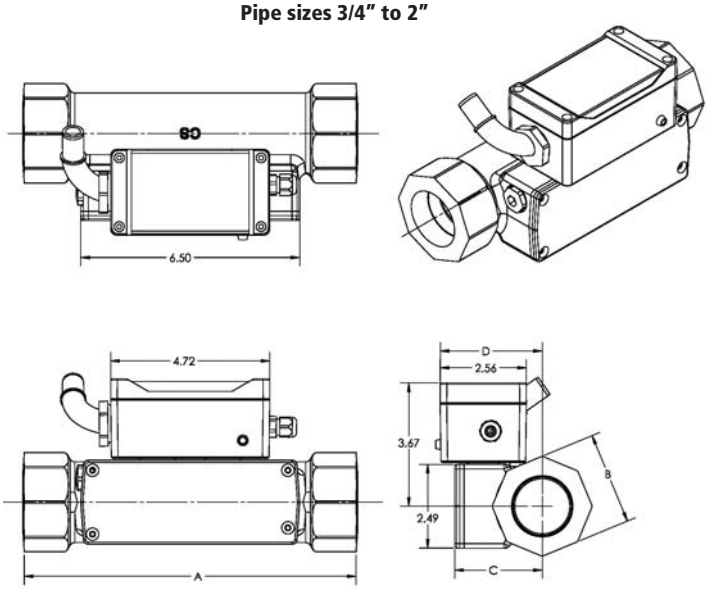
Commissioning from a personal computer is straightforward with Clark commissioning software. Download from our website at www.clarksol.com. Requires P/N 43-119 or USOPTL4-LS , RS 485 converter.

DIMENSIONS

3-10" Schedule 40 Carbon Steel Pipe, ASME 150 Flange



Pipe sizes 3/4" to 2"



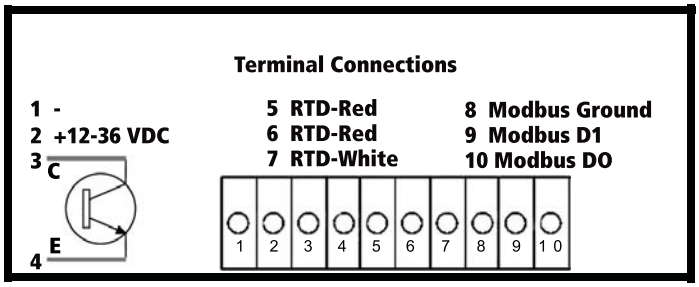
Meter Size ID	Table 8 Dimensions (Inches) A	B	C	D	E	F	Bolt Circle Dia.	Number of Holes - Dia.
3"	11.00	3.07	7.50	0.74	4.05	3.75	6.00	4 - 0.75
4"	13.00	4.03	9.00	.94	4.50	3.75	7.50	8 - 0.75
6"	16.00	3.06	11.00	1.00	5.60	3.75	9.50	8 - 0.88
8"	18.00	7.98	13.50	1.12	6.62	3.75	11.75	8 - 0.88
10"	22.00	10.02	16.00	1.19	7.69	3.75	14.25	12 - 1.0

Table 9 Dimensions (Inches) Size	A	B	C	D
3/4" & 1"	9.15	1.62	2.28	2.63
1-1/2" & 2"	9.85	2.75	2.59	3.02

ELECTRICAL

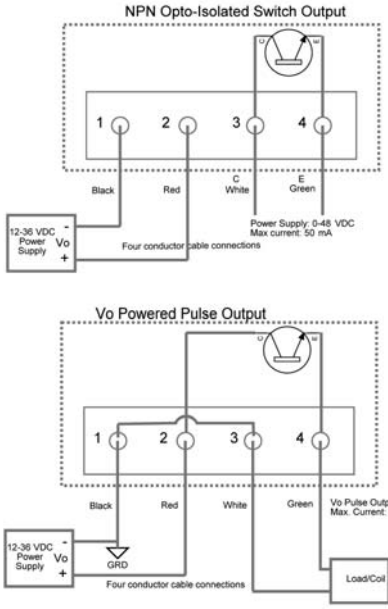
RS-485: 3-conductor cable
- Red: TXD1 (D1)
- Black: TXD0 (D0)
- Green or Clear: GND

Power & NPN TransistorOut:
- 4-conductor cable
- Red (+): V_{in} 12 to 30 VDC
- Black (-): V_{in} Return
- Green : OPTO NPN E
- White: OPTO NPN C



Optional RS-485 Converter for Commissioning from a PC:
Model 43-119: Use with comm port
Model USOPTL4-LS: Use with USB port
- PC End: DB9 Female
- RS-485 End: Terminal Block

Terminal Block Connections to CS-EM:
- Black: TD(A)-
- Red: TD(B)+
- Clear or Green: Gnd



Note: NPN Opto-isolated switch output (Order code I) and Vo Powered Pulse Output (order code V) are jumper selected at the factory.

ORDERING INFORMATION

Table 10

3/4" TO 2" ORDERING INFORMATION

ORDER NUMBER (ABCDE)

Example: CSEMB10-19-027NEI1

A	B	C	D	E		
Flow transmitter Model W/Remote Temp Probe	**Pipe Thread**	**Transducer Seal**	**Pulse Out Config.**	**1= Default Config. #1**	**2= Default Config. #2**	**3= Default**
See Table 2 for flow Transmitter Model detail See Table 1 for temperature probe detail CSEMB34-43-110 CSEMB34-19-027 CSEMB10-43-110 CSEMB10-19-027 CSEMB15-19-027 CSEMB20-19-027	N= Female NPT B=Female British Standard Pipe (G)	E= EPDM B= Buna-N N= Neo-prene® V= FKM	I=Opto-Isolated NPN V= Voltage Pulse	Pulse Output: 1 pulse = 1000 Btu (1 KBtu) Pulse Type: Universal Media: Water, no glycol Volume Flow Rate Units: Gallons/Min Mass Flow Rate Units: Lbs/Min Volume Total Units: Gallons Mass Total Units: Lbs Energy Rate Units: kBtu/Min Energy Total Units: kBtu Temperature Units: °F Min. Temp. Differential: 2°F Baud Rate: 9600 Parity: None Slave ID: 02	Pulse Output: 1 pulse = 1 KW-Hr Pulse Type: Universal Media: Water, no glycol Volume Flow Rate Units: Liters/Min Mass Flow Rate Units: KG/Min Volume Total Units: Liters Mass Total Units: KG Energy Rate Units: KW Energy Total Units: KW-Hrs Temperature Units: °C Min. Temp. Differential: 1.1°C Baud Rate: 9600 Parity: None Slave ID: 02	User Specified, user to fill out and submit configuration sheet (last page of this bulletin

Table 11

3" TO 10" ORDERING INFORMATION

ORDER NUMBER (ABCD)

Example: CSEMC4-19-028EI2

ULTEM® is a registered trademark of The General Electric Company

A	B	C	D		
Flow transmitter Model W/Remote Temp Probe	**Transducer Seal**	**Pulse Out Config.**	**1= Default Config. #1**	**2= Default Config. #2**	**3= Default Config. #3**
See Table 3 for flow Transmitter Model detail See Table 1 for temperature probe detail CSEMC3-19-028 CSEMC4-19-028 CSEMC6-19-029 CSEMC8-19-029 CSEMC10-19-030	E= EPDM B= Buna-N N= Neoprene® V= FKM	I=Opto-Isolated NPN V= Voltage Pulse	Pulse Output: 1 pulse = 1000 Btu (1 KBtu) Pulse Type: Universal Media: Water, no glycol Volume Flow Rate Units: Gallons/Min Mass Flow Rate Units: Lbs/Min Volume Total Units: Gallons Mass Total Units: Lbs Energy Rate Units: kBtu/Min Energy Total Units: kBtu Temperature Units: °F Min. Temp. Differential: 2°F Baud Rate: 9600 Parity: None Slave ID: 02	Pulse Output: 1 pulse = 1 KW-Hr Pulse Type: Universal Media: Water, no glycol Volume Flow Rate Units: Liters/Min Mass Flow Rate Units: KG/Min Volume Total Units: Liters Mass Total Units: KG Energy Rate Units: KW Energy Total Units: KW-Hrs Temperature Units: °C Min. Temp. Differential: 1.1°C Baud Rate: 9600 Parity: None Slave ID: 02	User Specified, user to fill out and submit configuration sheet (last page of this bulletin

Accessory	Description
RT-3-502	3-conductor RTD cable, 22 guage stranded tinned, PVC insulation, red, red, white. Specify Length.
M2244801	3-conductor shielded plenum wire, 22 AWG, PVC. Specify Length.

Accessory	Description
M2244802	4-conductor shielded plenum wire, 22 AWG, PVC . Specify Length.
43-119	RS-485 converter for commissioning from a PC Comm Port
USOPTL4-LS	RS-485 converter for commissioning from a PC USB Port

Instruments

Series 440 Programmable RTD Temperature Transmitter Specifications

Resistance Thermometer Input (RTD)

TYPE	MEASUREMENT RANGE	MINIMUM RANGE
Pt100 (α = 0.003 85 °C^{-1})	(-200 to 650) °C [-328 to 1202] °F	10 ˚C [18 ˚F]
Connection Type	2 or 3 wire connection cable resistance compensation possible in the 2 wire system (0 to 20) Ω	
Sensor cable resistance	maximum 11 Ω per cable	
Sensor current	≤ 0.6 mA	

Output (Analog)

Output signal	(4 to 20) mA or (20 to 4) mA
Transmission as	Temperature linear
Maximum load	($V_{power\ supply}$ - 10 V) / 0.023 A (current output)
Digital filter 1st degree	(0 to 8) s
Induced current required	≤ 3.5 mA
Current limit	≤ 23 mA
Switch on delay	4 s (during power 1_a = 3.8 mA)
Electronic response time	1 s

Failure Signal (fault monitoring)

Undershooting measurement range	Decrease to 3.8 mA
Exceeding measurement range	Increase to 20.5 mA
Sensor breakage/short circuit	≤ 3.6 mA or ≥ 21.0 mA

Electronic Connection

Power supply	U_b = (10 to 35) V dc, polarity protected
Allowable ripple	U_{ss} ≤ 5 V at U_b ≥ 13 V, f_{max} = 1 kHz

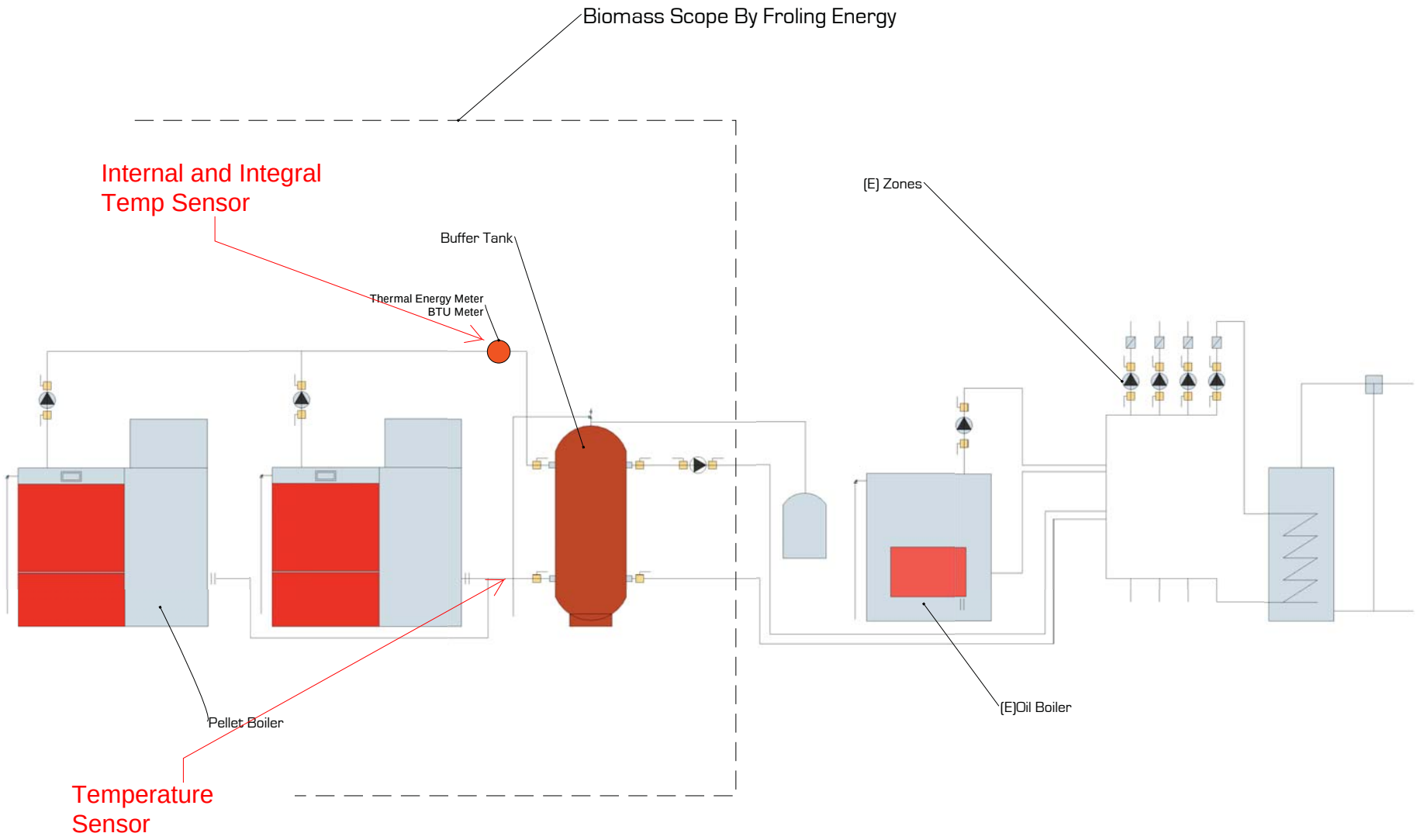
Resistance Thermometer Accuracy (RTD)

TYPE	MEASUREMENT ACCURACY
Pt100	0.2 °C or 0.08% [1]
Reference conditions	Calibration temperature (23 ± 5) °C [73 ± 9] °F

General Accuracy

Influence of power supply	± 0.01%/V deviation from 24 V [2]
Load influence	± 0.02%/100 Ω [2]
Temperature drift	T_d= ± (15 ppm/°C × (range end value + 200) + 50 ppm/°C × measurement range) × $\Delta\vartheta$ $\Delta\vartheta$ = deviation of the ambient temperature according to the reference condition
Long term stability	≤ 0.1 °C/year [3] or ≤ 0.05%/year [1][3]

[1] % is related to the adjusted measurement range (the value to be applied is the greater)
[2] All data is related to a measurement end value of 20 mA
[3] Under reference conditions



Charlestown Primary	Mechanical Schematic	01
	Froling Energy for EEI	M

REVISIONS

	MM/DD/YY	REMARKS
1	__/__/__	-
2	__/__/__	-
3	__/__/__	-
4	__/__/__	-
5	__/__/__	-

Davey Engineering & Construction Corp.

36 Pleasant Street
Canton, MA 02021
T. 781.575.1985
F. 781.828.1377

October 4, 2015

Ms. Teague
Fall Mountain School District
159 East Street
Charlestown, NH 03603

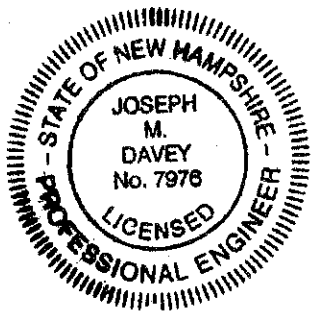
Dear Ms. Teague:

This letter is to inform you that the BTU meter on the Wood Pellet Boilers have been installed in accordance the manufacturer's guidelines at Charlestown Elementary are Walpole Elementary Schools.

We have completed a field inspection of the installed meters at both locations.

Please feel free to contact me with any questions at 781-948-8720

Sincerely,



Joseph M. Davey, PE
Principal

Photographs of BTU meter installation
Charlestown, NH

Temperature Sensor

Photograph Walpole, NH BTU meter

Temperature Sensor